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Groundwater – An Important Rural Resource

MANAGING THE QUANTITY OF GROUNDWATER SUPPLIES

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This is the second of four Factsheets that will help Ontario's farmers and rural residents learn more about groundwater — the availability of groundwater for rural use, the effect of pumping on aquifers and how to manage the use of, and impact on, groundwater.

Other Factsheets in this series include:

- *Understanding Groundwater* (Order No. 06-111)
- *Protecting the Quality of Groundwater Supplies* (Order No. 06-115)
- *Private Rural Water Supplies* (Order No. 06-117)

Groundwater is a valuable resource for rural families and businesses – in some situations it may be the only water source. When living in a rural area, it is important to understand what can be done to conserve water usage and ensure its future abundance.

GROUNDWATER SUPPLIES

A water supply well is a hole that is drilled, dug or bored into the ground or underlying bedrock from which groundwater can be drawn. Groundwater can also be tapped where it naturally flows to the surface in the form of springs. Both springs and wells have been known to dry up on occasion. A lack of groundwater affects not only well supplies, but also the lakes, rivers and wetlands that depend on the groundwater.

Aquifers are permeable formations that will yield useful amounts of water when pumped for water supplies. The amount of groundwater that can be pumped from an aquifer over time depends on an aquifer's size (storage capacity) and geological composition (ability to transmit water), as well as its water balance.

A water balance accounts for the water entering an aquifer through recharge and underground flow, the amount that leaves the aquifer through pumping or underground flow, and the amount that remains in the aquifer. For most untapped aquifers, the amount of water entering the aquifer (recharge) during an average year nearly balances or equals the amount leaving (discharge). As a result, the amount of water stored in the aquifer does not change much — it will increase slightly in rainy years and decrease slightly in drier years.

Aquifers are permeable formations that will yield useful amounts of water when pumped for water supplies. Aquitards are materials that prevent the significant flow of water. Water can move extremely slowly through aquitards. Aquifers and aquitards are discussed in more detail in OMAFRA Factsheet *Understanding Groundwater* (Order No. 06-111)

Groundwater is just one part of the global water cycle. Precipitation that seeps into the ground becomes groundwater that will then move underground toward a lake, stream or ocean where it discharges to become part of the surface water. The water then completes the cycle by evaporating into the atmosphere to become precipitation again.

Although many aspects of the water balance and water cycle, such as rainfall, are beyond human control, well owners can affect the water balance in an aquifer by the way in which the well is pumped. In some cases, an aquifer can be over-pumped to the point that it can no longer produce water. This is a particular problem where aquifers are small or are pumped excessively or too rapidly.

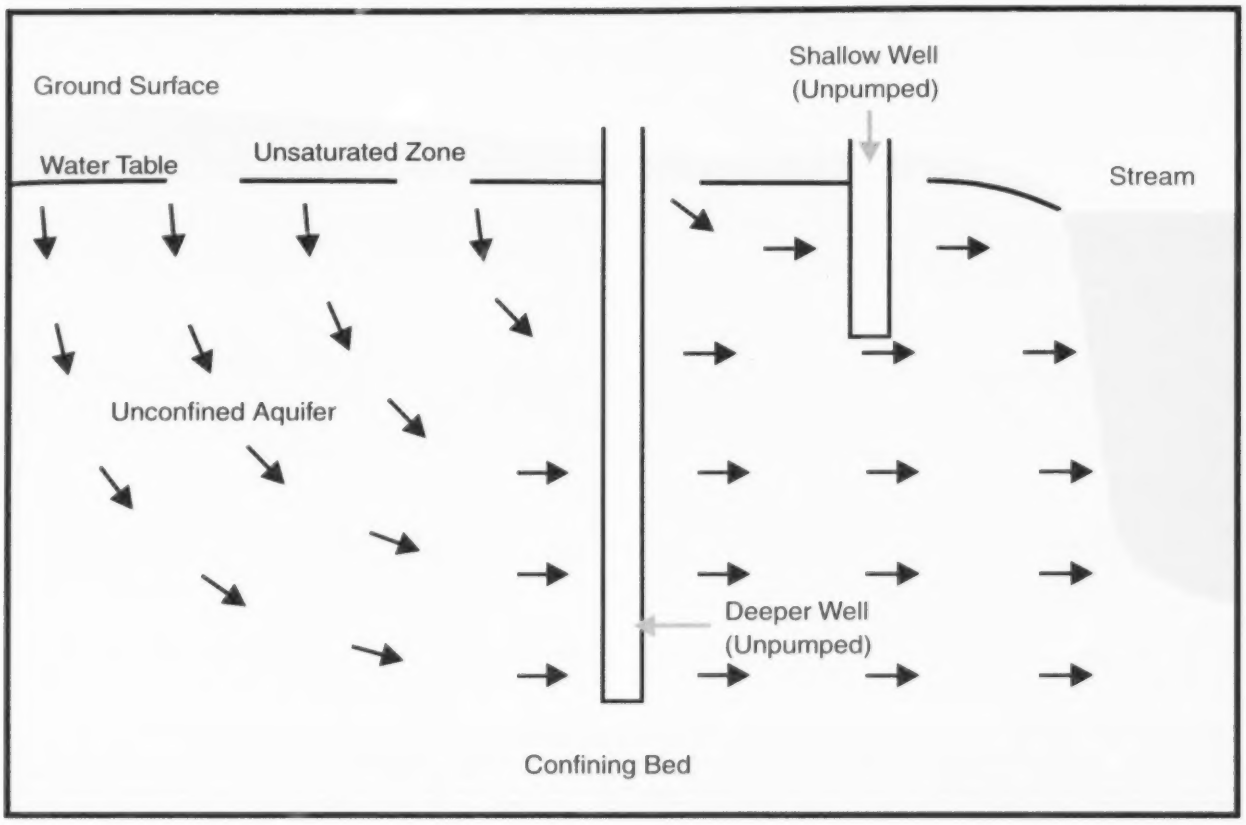

Figure 1. An unconfined aquifer before pumping.

EFFECT OF PUMPING A SUPPLY WELL

In an unpumped aquifer, water infiltrating the subsurface seeps down to the water table and then flows horizontally towards a discharge area (see Figure 1, above). An unconfined aquifer is one where the top of the aquifer is also the water table. When a well is pumped in an unconfined aquifer, water is removed from the aquifer, and the water table in the aquifer is lowered. This lowering or drawdown of the water table is greatest close to the well and gets smaller in all directions as the distance from the well increases (see Figure 2, next page). This pattern of drawdown in the aquifer is referred to as the cone of depression. The size and shape of the cone of depression will grow and shrink as the rate and duration of well pumping change.

Pumping, and the cone of depression (drawdown cone) it creates, causes water that would normally flow past a well on its trip through the aquifer to the stream (as part of the water cycle) to be captured by the pumping well and brought aboveground for use. Water recharged to the left of the "divide" will flow towards the well, and water recharged to the right of the "divide" will flow towards the stream. The groundwater removed from the aquifer may eventually be replaced by rain and snowmelt that seep into the ground and aquifer. However, the amounts may not exactly balance or recharge at the same time as our withdrawals, and the amount of water stored in the aquifer will change.

The pumping well does not capture water from the stream (Figure 2), but if the well is pumped at a high enough rate or pumped long enough, the flow divide will move towards the stream, and some water from the stream will be drawn into the aquifer and eventually pumped out of the well. Some wells near streams or rivers may get the majority of their water from surface water in this way and may potentially reduce the amount of water flowing in the stream.

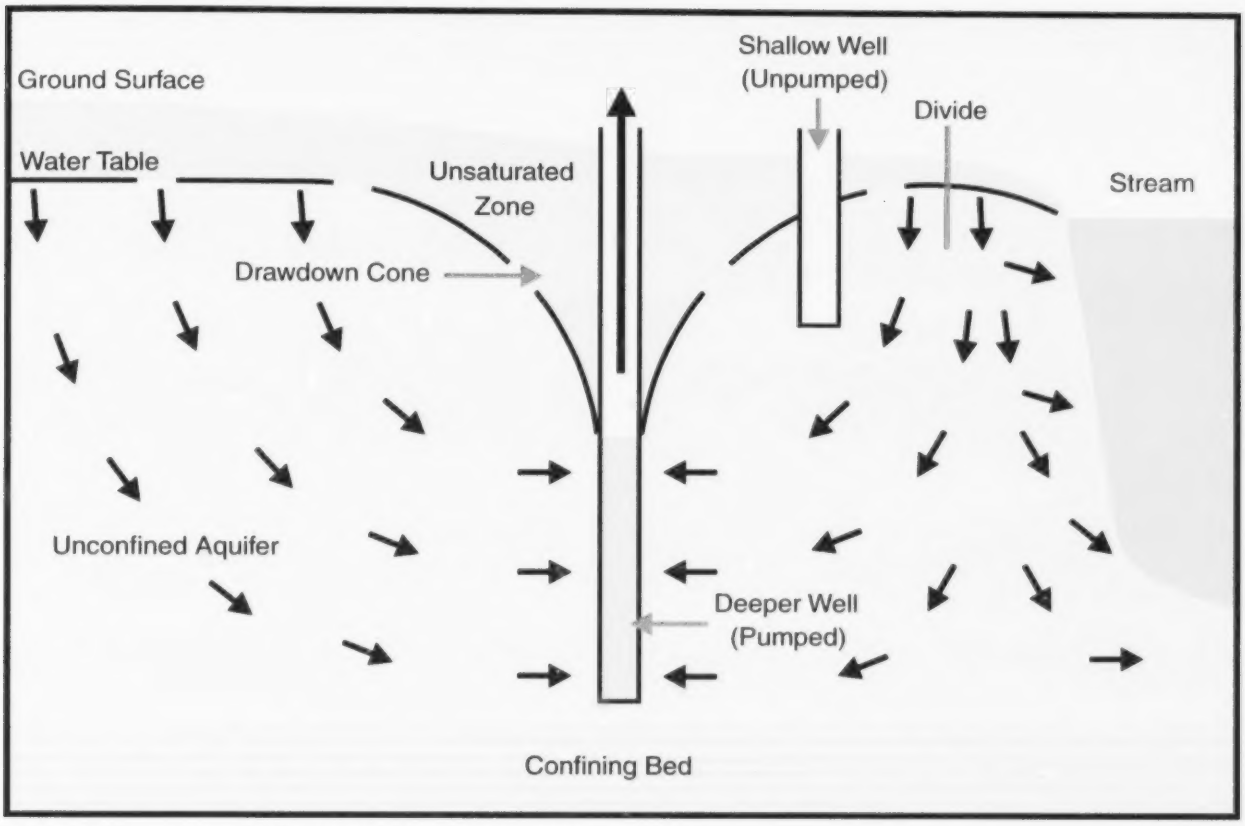

Figure 2. An unconfined aquifer showing the water table during pumping.

MANAGING YOUR GROUNDWATER RESOURCE AND WELL

There are three main causes of running low on water.

1. There is not enough volume of water (or a sufficiently high water table) in the aquifer to supply the needs of rural homes, businesses or farms.

2. The water is pumped at a rate faster than the water can move through the aquifer to get to the well.

3. The well is not constructed to pump as much water as is needed.

When considering a significant increase in water use, it is important to know in advance if the well and the aquifer it taps, can supply the amount of water needed. The first step is to measure (if you have a water meter) or estimate the current and projected water usage. Next, contact a licensed well professional or professional geoscientist (hydrogeologist) to determine if the well and aquifer can meet the increased demand, and if the well has the proper pump size. Professionals can also help determine the well yield, which is the maximum rate that you can pump a well and still have the water level in the well remain above the pump intake.

If a well pumps more than 50,000 L of water per day, a Permit to Take Water is required. More information on the Permit to Take Water program is available on the Ontario Ministry of the Environment website, www.ene.gov.on.ca/water.htm.

To ensure an ongoing supply of groundwater, consider the following actions:

- Reduce water use by using water efficiently.
- Reduce the size of the pump to reduce the drawdown during pumping.
- Modify the system by installing a larger pressure tank; this may be especially important if the well has a limited depth of water inside the casing during pumping (limited available drawdown), or if the aquifer is shallow or not very productive.

Water levels in the aquifer can drop to the point that water can no longer be pumped. This drop can occur when the demand (pumping) is greater than the supply, or when extended dry periods happen. Figure 2, above, illustrates a deep well that has been pumped to the point of lowering the water level in a shallow well.

In some cases, it may be necessary to try to find a larger and more productive supply (such as a deeper aquifer) that can be tapped for personal water supply needs. If this is the case, consider tapping into an aquifer that has a lower vulnerability to contamination. The importance of aquifer vulnerability is discussed in more detail in OMAFRA Factsheet, *Protecting the Quality of Groundwater Supplies* (Order No. 06-115).

OTHER SOURCES OF INFORMATION

OMAFRA. *Best Management Practices: Water Wells*, Order No. BMP 12.

Ontario Ministry of the Environment. *Well Aware – A Well Owner's Guide* (videotape).

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